MICROPROCESSORS

AND

MICROCONTROLLERS

(EE6502)

2 MARKS QUESTION BANK

UNIT 1
8085 PROCESSOR
TWO MARKS

1. What is microprocessor? Give the power supply &clock frequency of 8085

A microprocessor is a multipurpose, programmable logic device that reads binary instructions from a storage device called memory accepts binary data as input and processes data according to those instructions and provides result as output. The power of 8085 is +5v and clock frequency in 3MHZ.

2. List the allowed register pairs of 8085.

B-C register pair D-E register pair H-L register pair.

3. Mention the purpose of SID and SOD lines. (May/Jun 2016)

SID (serial input data line):

It is an input line through which the microprocessor accepts serial data.

SOD (serial output data line):

It is an output line through which the microprocessor sends output serial data.

4. What is an opcode ?

The part of the instruction that specifies the operation to be performed is called the operation code or opcode.

5. What is the function of IO/M signal in the 8085?

It is a status signal. It is used to differentiate between memory locations and I/O operations when this signal is low (IO/M=0) it denotes the memory related operations. When this signal is high (IO/M=1) it denotes an I/O operation

6. What is meant by wait state?

This state is used by slow peripheral devices. The peripheral devices can transfer the data to or from the microprocessor by using READY input line. The microprocessor remains in the wait state as long as READY line is low. During the wait state, the contents of the address, address/data and control buses are held constant.

7. Explain priority interrupts of 8085?

The 8085 microprocessor has five interrupt inputs. They are TRAP, RST 7.5, RST 6.5, RST 5.5, and INTR. These interrupts have a fixed priority of interrupt service. If two or more interrupts go high at the same time, the 8085 will service them on priority basis. The TRAP has the highest priority followed by RST7.5, RST6.5, and RST5.5. The priority of interrupts in 8085 is shown below.

Interrupts	Priority
TRAP	1
RST7.5	2
RST6.5	3
RST5.5	4
INTR	5

8. What is the signal classification of 8085?

All the signals of 8085 can be classified into 6 groups

1. Address bus
2. Data bus
3. Control and status signals
4. Power supply and frequency signals
5. Externally initiated signals
6. Serial I/O ports

9. Steps involved to fetch a byte in 8085?

i) The pc places the 16-bit memory address on the address bus

ii) The control unit sends the control signal RD to enable the memory chip

iii) The byte from the memory location is placed on the data bus

iv) The byte is placed in the instruction decoder of the microprocessor and the task is carried out according to the instruction.

10. Define instruction cycle, machine cycle and T-state?

Instruction cycle is defined as the time required completing the execution of an instruction.

Machine cycle is defined as the time required completing one operation of accessing memory, I/O or acknowledging an external request.

T –cycle is defined as one subdivision of the operation performed in one clock period.

11. How many machine cycles does 8085 have, mention them?

The 8085 have seven machine cycles they are

1. Opcode fetch
2. Memory read
3. Memory write
4. I/O read
5. I/O write
6. Interrupt acknowledge
7. Bus idle

12. Define flags?

The flags are used to reflect the data conditions in the accumulator. The 8085 flags are SIGN FLAG, ZERO FLAG, AUXILLARY FLAG, PARITY FLAG, CARRY FLAG

D7	D6	D5	D4	D3	D2	D1	D0
S	Z		AC		P		CY

13. Difference between memory mapped I/O and peripheral I/O ?

MEMORY MAPPEED I/O	PERIPHERAL I/O
16-bit device address	8-bit device address
The data transfer between any general-purpose register and I/O port	The data transfer only between accumulator and I/O port
The memory map(64 kB)is shared between I/O device and system memory	The I/O map is independent of the memory map, 256 input device and 256 output device

More hardware is required to decode 16-bit Address	Less hardware is required to decode 8-bit Address

14. Write the function of Program counter. (May/Jun 2016)

It is used to points the address of next instruction to be executed. PC is incremented on execution of every instruction.

15. Write a ALP to add two digit BCD numbers. (Dec 2016)

```
LDA 000
MOV B, A
LDA 001
MIV C, 00
ADD D
DAA
JNC LAB1
INR C
[LAB1] STA 002
MOV A, C
STA 003
HLT
```

16. List out the machine cycles for executing the instruction MVI A, 34 H. (Dec 2016)

(i) Opcode Fetch (4 T states)
(ii) Memory Read (3 T states)

UNIT 2

PROGRAMMING OF 8085 PROCESSOR

TWO MARKS

1. What is an instruction?

An instruction is a binary pattern entered through an input device to command the microprocessor to perform that specific function.

2. How many operations are there in the instruction set of 8085 microprocessor?

There are 74 operations in the 8085 microprocessor

3. List out the five categories of the 8085 instructions. Give ex of the instructions for each group?

1. Data transfer group – MOV,MVI,LXI
2. Arithmetic group – ADD,SUB,INR.
3. Logical group- ANA,XRA,CMP.
4. Branch group – JMP,JNZ,CALL.
5. Stack I/O and machine control group – PUSH,POP,IN,HLT.

4. Explain the function of JMP instruction and CALL instruction. (Dec 2016)

A JMP instruction permanently changes the program counter. A CALL instruction leaves information on the stack so that the original program execution sequence can be resumed.

5. Explain the purpose of the I/O instructions IN and OUT

The IN instruction is used to move data from an I/O port in to the accumulator.
The OUT instruction is used to move data from the accumulator to an I/O port.
The IN and OUT instructions are used only on microprocessor, which use a separate address space for interfacing.

6. What is the difference between the shift and rotate instructions?

A rotate instruction is a closed loop instruction. That is, the data moved out at one end is put back in at the other end. The shift instruction loses the data that is moved out of the last bit locations.

7. List the four instructions which control the interrupt structure of the 8085 microprocessor?

DI (disable interrupts), EI (enable interrupts)
RIM (read interrupt masks) SIM (set interrupt masks)

8. Mention the categories of instruction and give two examples for each category?

The instructions of 8085 can be categorized in to the following five

1. Data transfer - MOV,STA 16-BIT
2. Arithmetic- ADD R, DCR M.
3. Logical - XRI 8- bit, RAR
4. Branching - JNZ ,CALL 16-bit
5. Machine control- HLT,NOP

9. Explain LDA,STA & DAA instructions

LDA copies the data byte in to the accumulator from the memory location specified by

the 16-bit address. STA copies the data byte from the accumulator in the memory location specified by 16-bit address. DAA changes the content of the accumulator from binary to 4-bit BCD digits.

10. Explain the different instruction formats with example?

The instruction set is grouped in to the following formats

One byte instruction MOV C, A

Two byte instruction MVI A, 39H

Three byte instruction JMP 2345H

11. What is the use of addressing modes, mention the different types? (Dec 2016)

The various formats of specifying the operands are called as addressing modes , it is used to access the operands or data. The different types are as follows

1. Immediate addressing
2. Register addressing
3. Direct addressing
4. Indirect addressing
5. Implicit addressing

12. Define stack and stack related instructions? (May/Jun 2016)

The stack is a group of memory locations in the R/W memory that is used for the temporary storage of binary information during the execution of the program. The stack related instructions are PUSH and POP

13. Why do we use XRA A instruction?

The XRA A instruction is used to clear the contents of the accumulator and store the value 00H.

14. How does the microprocessor differentiate b/w data and instruction ?

When the first m/c code of an instruction is fetched and decoded in the instruction register, the microprocessor recognizes the number of bytes required to fetch the entire instruction. For example MVI A, data, the second byte is always considered as data. If the data byte is omitted by mistake whatever is in that memory location will be considered as data and the byte after the "data "will be treated as the next instruction.

15. Compare RET and POP instructions

RET	POP
RET transfers the content of the top two locations of the stack on the PC	**POP transfers the content of the top two locations of the stack to the specified register pair**
When RET is Executed the SP is incremented by TWO and it has 8 conditional instructions .	**When POP is Executed the SP is incremented by TWO and it has no conditional instructions .**

16. What are procedures?

Procedures are group of instructions stored as a separate program in memory and it is called from the main program in memory and it is called from the main program whenever required. The type of procedure depends on where the procedures are stored in memory. If it is in the same code segment as that of the main program then it is a near procedure otherwise it is a far procedure.

17. What is a recursive procedures? (May/june 2016)

A recursive procedure is a procedure, which calls itself. Recursive procedures are used to work with complex data structures called trees. If the procedure is called with N=3, then the N is decremented by 1 after each procedure CALL and the procedure is called until N=0.

18. How to access subroutine with in the main program procedure?

i) accessed by CALL & RET instruction

ii) Machine code of instruction is placed only once in the memory

iii) With procedures less memory is required

iv) Parameters can be passed in registers, memory location or stack

19. Define stack?

Stack is a sequence of RAM memory locations defined by the programmer.

20. How the microprocessor is synchronized with peripherals?

The timing and control unit synchronizes all the microprocessor operations with clock and generates control signals necessary for communication between the microprocessor and peripherals.

UNIT 3

8051 MICRO CONTROLLER

TWO MARKS

1. What is mean by microcontroller?

A device which contains the microprocessor with integrated peripherals like memory, serial ports, parallel ports, timer/counter, interrupt controller, data acquisition interfaces like ADC, DAC is called microcontroller.

2. Explain DJNZ instruction of Intel 8051 microcontroller?

a) DJNZ Rn, rel

Decrement the content of the register Rn and jump if not zero.

b) DJNZ direct, rel

Decrement the content of direct 8- bit address and jump if not zero.

3. State the function of RS1 and RS0 bits in the flag register of Intel 8051 microcontroller?

RS1, RS0- Register bank select bits RS1, RS0- Bank

Bank 0
Bank 1
Bank 2
Bank 3

4. Give the alternate functions for the port pins of port3?

RD WR T1 T0
INT 1 INT 0 TXD RXD

RD – Read data control output
WR – Write data control output
T1 – Timer / counter 1 external input or test pin
T0 – Timer / counter 0 external input or test pin
INT 1 – Interrupt 1 input pin
INT 0 – interrupt 0 input pin
TXD – Transmit data pin for serial port in UART mode
RXD – Receive data pin for serial port in UART mode

5. Specify the single instruction, which clears the most significant bit of B register of 8051, without affecting the remaining bits.

Single instruction, which clears the most significant bit of B register of 8051, without affecting the remaining bits, is CLR B.7.

6. Explain the function of the pins PSEN and EA of 8051. (Dec 2016)

PSEN: PSEN stands for program store enable. In 8051 based system in which an external ROM holds the program code, this pin is connected to the OE pin of the ROM.

EA: EA stands for external access. When the EA pin is connected to Vcc, program fetched to

address 0000H through 0FFFH are directed to the internal ROM and program fetches to addresses 1000H through FFFFH are directed to external ROM/EPROM. When the EA pin is grounded, all addresses fetched by program are directed to the external ROM/EPROM.

7. Explain the 16-bit registers DPTR and SP of 8051.

DPTR:

DPTR stands for data pointer. DPTR consists of a high byte (DPH) and a low byte (DPL). Its function is to hold a 16-bit address. It may be manipulated as a 16- bit data registers. It serves as a base register in indirect jumps, lookup table instructions and external data transfer.

SP:

SP stands for stack pointer. SP is a 8-bit wide register. It is incremented before data is stored during PUSH and CALL instructions. The stack array can reside anywhere in-chip RAM. The stack pointer is initialized to 07H after a reset. This causes the stack to begin at location. 08H.

8. Name the special functions registers available in 8051.

Accumulator B Register
Program status Word.
Stack pointer. Data pointer
Port 0 Port 1 Port 2 Port 3
Interrupt priority control register.
Interrupt enable control register

9. Explain the register IE format of 8051.

EA ET2 ES
ET1 EX1 ET0 EX0
EA- Enable all control bit.
ET2- Timer 2 interrupt enable bit.
ES- Enable serial port control bit.
ET1- Enable Timer1 control bit.
EX1-Enable external interrupt1 control bit. ET0-Enable Timer0 control bit. EX0- Enable external interrupt0 control bit.

10. Name the five interrupt sources of 8051? (Dec 2016)

External interrupt 0 : IE0: 0003H
Timers interrupt 0 : TF0: 000BH
External interrupt 1 : IE1: 0013H T
Timers interrupt 1 : TF1:001BH
Serial interrupt
Receive interrupt: RI: 0023H
Transmit interrupt: TI: 0023H

11. Write a program to subtract the contents of RI of Bank0 from the contents of R0 0f Bank2.

```
MOV PSW, #10
MOV A, R0
```

MOV PSW,
#00 SUBB
A, R1

12. How the RS-232 serial bus is interrupt to 1TL logic device?

The RS-232 signal voltage level devices are not compatible with TTL logic levels. Hence for interfacing TTL devices to RS-232 serial bus, level converters are used. The popularly used level converters are MC 1488 & MC 1489 or MAX 232.

13. List the features of 8051 microcontroller? (May/Jun 2016)

The features are

- Single supply +5 volt operation using HMOS technology.
- 4096 bytes program memory on chip (not on 8031)
- 128 data register banks
- Four register mode, 16-bit timer/ counter.
- Extensive Boolean processing capabilities.
- 64 KB external RAM size
- 32 bi-directional individually addressable I/O lines.
- 8 bit CPU optimized for control applications.

14. Explain the operating mode 0 of 8051 serial ports? (May/Jun 2016)

In this mode serial enters & exits through RXD, TXD outputs the shift clock 8 bits are transmitted/received: 8 data bits (LSB first). The baud rate is fixed at 1/12 the oscillator frequency.

15. Explain the operating mode 0 of 8051 ports? (May/Jun 2016)

In this mode 11 bits are transmitted (through TXD) or received (through RXD): a start bit (0), 8 data bits (LSB first) a, programmable 9^{th} data bit, & a stop bit (1).ON transmit the 9^{th} data bit (TB* in SCON) can be assigned the value of 0 or 1.

For example : the parity bit (P, in the PSW) could be moved into TB8. On receive the 9^{th} data bit go in to the RS8 in Special Function Register SCON, while the stop bit is ignored. The baud rate is programmable to either 1/32, or 1/64 the oscillator frequency.

16. Explain the mode 3 of 8051 serial ports?

In this mode 11 bits are transmitted (through TXD) or received (through RXD): a start bit (0), 8 data bits (LSB first) a, programmable 9^{th} data bit, & a stop bit (1). In fact, Mode 3 is the same as Mode 2 in all respect except the baud rate. The baud rate in Mode 3 is variable.

In all the four modes, transmission is initiated by any instruction that uses SBUF as a destination register. Reception is initiated in Mode 0 by the condition RI=0 & REN=1. Reception is initiated in other modes by the incoming start bit if REN=1.

17. List the addressing modes of 8051?

Direct addressing
Register addressing
Register indirect addressing
Implicit addressing
Immediate addressing Index addressing
Bit addressing

UNIT 4

PERIPHERAL INTERFACING

TWO MARKS

1. What is the use of 8251 chip?

Intel's 8251 is a universal synchronous asynchronous receiver and transmitter compatible with Intel's Processors. This may be programmed to operate in any of the serial communication modes built into it. This chip converts the parallel data into a serial stream of bits suitable for serial transmission. It is also able to receive a serial stream of bits and converts it into parallel data bytes to be read by a microprocessor.

2. What are the different types of methods used for data transmission?

The data transmission between points involves unidirectional or bi-directional transmission of meaningful digital data through a medium. There are basically there modes of data transmission

(a)Simplex

(b) Duplex

(c) Half Duplex

In simplex mode, data is transmitted only in one direction over a single communication channel. For example, a computer (CPU) may transmit data for a CRT display unit in this mode.

In duplex mode, data may be transferred between two trans receivers in both directions simultaneously.

In half duplex mode, on the other hand, data transmission may take place in either direction, but at a time may be transmitted only in one direction. For example, a computer may communication with a terminal in this mode. When the terminal sends data (i.e. terminal is sender).The message is received by the computer (i.e. computer is receiver). However, it is not possible to transmit data from the computer to terminal and from terminal to the computer simultaneously.

3. What is the various programmed data transfer method?

ii) Asynchronous data transfer

iii) Interrupt driven data transfer

4. What is synchronous data transfer?

It is a data method which is used when the I/O device and the microprocessor match in speed. The transfer a data to or from the device, the user program issues a suitable instruction addressing the device. The data transfer is completed at the end of the execution of this instruction

5. What is asynchronous data transfer?

It is a data transfer method which is used when the speed of I/O device does not match with the speed of the microprocessor. Asynchronous data transfer is also called as Handshaking..

6. What are the functional types used in control words of 8251a?

The control words of 8251A are divided into two functional types

1. Mode Instruction control word
2. Command Instruction control word

Mode Instruction control word: - This defines the general operational characteristics of 8251A.

Command Instruction control word: - The command instruction controls the actual operations of the selected format like enable transmit/receiver, error reset and modem control.

7. What are the basic modes of operation of 8255?

There are two basic modes of operation of 8255, viz.

1. I/O mode.
2. BSR mode

In I/O mode, the 8255 ports work as programmable I/O ports, while in BSR mode only port C (PC0-PC7) can be used to set or reset its individual port bits. Under the IO mode of operation, further there are three modes of operation of 8255, So as to support different types of applications, viz. mode 0, mode 1, and mode 2.

Mode 0- Basic I/O mode
Mode 1-Strobe I/O mode
Mode 2- Strobe bi-direction I/O

8. Write the features of mode 0 in 8255?

1. Two 8-bit ports (port A and port B) and two 4-bit ports (port C upper and lower) are Available. The two 4-bit ports can be combined used as a third 8-bit port.
2. Any port can be used as an input or output port.
3. Output ports are latched. Input ports are not latched.
4. A maximum of four ports are available so that overall 16 I/O configurations are possible.

9. What are the features used mode 1 in 8255?

Two groups A and group B are available for strobe data transfer.

1. Each group contains one 8-bit data I/O port and one 4-bit control/data port.
2. The 8-bit data port can be either used as input or output port. The inputs and outputs both are latched.
3. Out of 8-bit port C, PC0-PC2 is used to generate control signals for port B and PC3=PC5 are used to generate control signals for port A. The inputs PC6, PC7 may be used as independent data lines.

10. What are the signals used in input control signal and output control signals?

Input control signals	**Output control signals**
STB (Strobe input)	IBF (Input buffer full)
INTR (Interrupt request)	Output control signal
OBF (Output buffer full)	ACK (Acknowledge input)
INTR (Interrupt request)	

11. What are the features used in 8255 mode 2? (May/Jun 2016)

The signals 8-bit port in group A is available.

1. The 8-bit port is bi-directional and additionally a 5-bit control port is available.
2. Three I/O lines are available at port C, viz PC2-PC0.
3. Inputs and output are both latched.
4. The 5-bit control port C (PC3-PC7) is used for generating/accepting handshake Signals for the 8-bit data transfer on port A.

12. What are the modes of operation used in 8253?

Each of the three counters of 8253 can be operated in one of the following six modes of operation.

1. Mode 0 (Interrupt on terminal count)
2. Mode 1 (Programmable monoshot)
3. Mode 2 (Rate generator)
4. Mode 3 (Square wave generator)
5. Mode 4 (Software triggered strobe)
6. Mode 5 (Hardware triggered strobe)

13. What are the different types of write operations used in 8253?

There are two types write operation in 8253

(1) Writing a control word register
(2) Writing a count value into a count register

The control word register accepts data from the data buffer and initialize

(a) Initializing the operating modes (mode 0- mode 4)
(b) Selection of counters (counter 0- counter 2)
(c) Choose binary /BCD counters.
(d) Loading of the counter registers.

The mode control register is a write only register and the CPU cannot read its contents.

14. Give the different types of command words used in 8259A

The command words of 8259A are classified in two groups

1. Initialization command words (ICWs)
2. Operation command words (OCWs)

15. Give the operation modes of 8259A?

(a) Fully Nest Mode
(b) End of Interrupt
(c) Automatic Rotation
(d) Automatic EOI mode
(e) Specific Rotation
(f) Special Mask Mode
(g) Edge and level Triggered Mode
(h) Reading 8259 Status
(i) Poll command
(j) Special Fully Nested Mode
(k) Buffered Mode
(l) Cascade Mode

16. Define scan counter?

The scan counter has two modes to scan the key matrix and refresh the display. In the encoded mode, the counter provides binary count that is to be externally decoded to provide the scan lines for keyboard and display. In the decoded scan mode, the counter internally decodes the least significant 2 bit and provides a decoded 1 out of 4 scan on SL3-SL 3. The keyboard and display both are in the same mode at a time.

17. What is the output modes used in 8279?

1.8279 provides two output modes for selecting the display options.

2. In this mode, 8279 provides 8 or 16 character- multiplexed displays those can be organized as dual 4-bit or single 8-bit display units.

3.Display Entry 8279 allows options for data entry on the displays. The display data is entered for display from the right side or from the left side.

18. What are the modes used in display modes?

1. Left Entry Mode

In the left entry mode, the data is entered from the left side of the display .

2. Right Entry Mode

In the right entry mode, the first entry to be displayed is entered on the rightmost display.

19. What is the use of modem control unit in 8251?

The modem control unit handles the modem handshake signals to coordinate the communication between the modem and the USART.

20. List the operation modes of 8255?

a) I/O Mode
   i. Mode 0- Simple Input/Output.
   ii. Mode 1- Strobe Input/Output (handshake mode)
   iii. Mode 2- Strobe bi-directional mode
b) Bit Set/Reset Mode.

21. What is a control word?

It is a word stored in a register (control register) used to control the operation of a program digital device.

22. What is the purpose of control word written to control register in 8255?

The control words written to control register specify an I/O function for each I/O port. The bit D7 of the control word determines either the I/O functions of the BSR function.

23. What is the size of ports in 8255?

Port - A : 8- bits	Port - B : 8- bits
Port -CU : 4- bits	Port -CL : 4- bits

24. What is an USART?

USART stands for universal Synchronous / Asynchronous Receiver / Transmitter. It is a programmable communication interface that can communicate by using either synchronous or asynchronous serial data.

25. What is the use of 8251 chip?

8251 chip is mainly used as the asynchronous serial interface between the processor and the external equipment.

26. List the major components of the Keyboard/ Display interface.

a. Keyboard section b. Scan section c. Display section d. CPU interface

Section

27. What is Key bouncing?

Mechanical switch are used as keys in most of the keyboard. When a key is pressed the contact bounce back and forth and settle down only after a small time delay (about 20ms). Even though a key is actuated once, it will appear to have been actuated several times. This problem is called Key Bouncing.

28. What is TXD?

TXD- Transmitter Data Output

This output pin carries serial of the transmitted data bits along with other information like start bit, stop bits and priority bit.

29. Define HRQ?

The hold request output request the access of the system bus. In non- cascaded 8257 systems, this is connected with HOLD pin of CPU. In cascade mode, this pin of a slave is connected with a DRQ input line of the master 8257, while that of the master is connected with HOLD input of the CPU.

30. What is RXD?

RXD- Receive Data Input

This input pin of 8251A receives a composite stream of the data to be received by 8251A.

31. What are the internal devices of a typical DAC? (May/Jun 2016)

The internal devices of a DAC are R/2R resistive network, an internal latch and current to voltage converting amplifier.

32. What is setting or conversion time in DAC?

The time taken by the DAC to convert a given digital data to corresponding analog signal is called conversion time.

33. What are the different types of ADC?

The different types of ADC are successive approximation ADC, counter type ADC, flash type ADC, integrator converters and voltage to frequency converters.

34. Write the features of 8259 (Dec 2016)

- It can handle 8 levels of interrupts.
- It can be cascaded in master-slave configuration to handle 64 levels of interrupts.
- Internal priority resolver.
- Fixed priority mode and rotating priority mode.
- Individually maskable interrupts.
- Modes and masks can be changed dynamically.
- No clock required.

UNIT 5

MICRO CONTROLLER PROGRAMMING & APPLICATIONS

TWO MARKS

1. Write a program using 8051 assembly language to change the data 55h stored in the lower byte of the data pointer register to AAH using rotate instruction?

```
MOV DPL,#55H
MOV A,DPL
LABEL :  SJMP  Label
```

2. Explain the contents of the accumulator after the execution of the following program segments?

```
MOV  A,#3CH
MOV  R4,#66H
ANL A,R4
```

A 3C
R4 66
A 24

3. Write a program to load accumulator A, DPH and DPL with 30H?

```
MOV A,#30
MOV DPH,A
MOV DPL,A
```

4. Write a program to perform multiplication of 2 no's using 8051?

```
MOV A,#data 1
MOV B,#data 2
MUL AB
MOV DPTR,#5000
MOV          @DPTR,A(lower
value) INC DPTR
MOV A,B
MOVX@DPTR,A
```

5. Write a program to mask the 0^{th} &7^{th} bit using 8051?

```
MOV A,#data
ANL A,#81
MOV DPTR,#4500
MOVX @DPTR,A
LOOP SJMP LOOP
```

6. Write about CALL statement in 8051?

There are two subroutine CALL instructions.
they are *LCALL(Long CALL)
*ACALL(Absolute CALL)
Each increments the pc to the 1^{st} byte of the instruction & pushes them in to the stack.

7. Write about the jump statement?

There are three forms of jump.
they are LJMP(Long-jump)-address
16 AJMP(Absolute jump)-address 11
Sjmp(short jump)-relative address

8. Write a program to load accumulator DPH & DPL using 8051?

```
MOV A,#30
MOV DPH,A
MOV DPL,A
```

9. Write a program to find 2's complement using 8051? (May/Jun 2016)

```
MOVA,R0
CPL A
INC A
```

10. Write a program to add two 8-bit numbers using 8051?

```
MOV  A,#30H
ADD A,#50H
```

11. Write a program to swap two numbers using 8051?

```
MOV  A,#data
SWAP A
```

12. Write a program to subtract two 8-bit numbers & exchange the digits using 8051?

```
MOV A,#9F
MOV R0,#40
SUBB A,R0
SWAP A
```

13. Write a program to subtract the contents of R1 of bank 0from the contents of R0 of bank 2 using 8051?

```
MOV PSW,#10
MOV A,R0
MOV PSW,#00
SUBB A,R1
```

14. Explain the operating mode0 of 8051 serial ports?

In this mode serial enters & exits through RXD,TXD output the shift clock 8 bits are transmitted or received 8 data bits(LSB first).the baud rate is fixed at 1/12 the oscillator frequency.

15. Explain the operating mode2 of 8051 serial ports?

In this mode 11 bits are transmitted (through TXD)or received(through RXD)A start bit(0),8 data bits(LSB first),a programmable 9^{th} data bit & a stop bit(1) ON transmit the 9^{th} data bit(TB*in SCON) can be assigned the value of 0 or 1.or for eg: the parity bit(pin the PSW) could be moved into TB8. On receive the 9^{th} data bit go in to the RB8 in special function register SCON, while the stop bit is ignored. The baud rate is programmable to either 1/32 or 1/64 the oscillator frequency.

16. Explain the mode3 of 8051 serial ports?

In this mode 11 bits are transmitted (through TXD)or received(through RXD): a start bit(0).8 data bits(LSB first), a programmable 9^{th} data bit,& a stop bit(1).in fact, mode3 is the same as mode2 in all respects except the baud rate. The baud rate in mode3 is variable. In all the four modes, transmission is initiated by any instruction that uses SBUF as a destination register. Reception is initiated by any instruction that uses SBUF as a destination register. Reception is initiated in mode0 by the condition R1=0 & REN=1.reception is initiated in other modes by the incoming start bit if REN-1.

17. What are the tasks involved in keyboard interfacing?

The task involved in keyboard interfacing are sensing a keyboard interfacing are sensing a key actuation, de bouncing the key and generating key codes(decoding the key).these task are hardware if the keyboard is interfaced through 8279.

18. How a keyboard matrix is formed in keyboard interface ? (May/Jun 2016)

The return lines RL0 to RL7 of 8279 are used to form the columns of keyboard matrix.in decoded scan the scan lines SLO to SL3 of 8279 are used to form the rows of keyboard matrix. In encoded scan mode, the output lines of external decoder are used as rows of keyboard matrix.

19. What is scanning in keyboard and what is scan time?

The process of sending a zero to each row of a keyboard matrix and reading the columns for key actuation is called scanning. the scan time is the time taken by the processor to scan all the rows one by one starting from first row and coming back to the first row.

20. What is scanning in display and what is the scan time?

In display devices the process of sending display codes to 7-segment LED'S to display the led's one by one is called scanning. The scan time is the time taken to display all the 7-segment LED'S one by one, starting from first LED and coming back to the first LED again.

21. Give some ex of input devices to microprocessor-based systems

The input devices used in the microprocessor- based system are keyboards, DIP switches, ADC, floppy disc, etc.

22. What is the use of PSW in 8051 microcontroller? (Dec 2016)

Flag register in 8051 is called as program status word (PSW). This special function register PSW is also bit addressable and 8 bit wide means each bit can be set or reset

independently. This is used to set / reset flags based on the arithmetic and logical operations performed by 8051.

23. Mention any four data transfer instructions of 8051 MC. (Dec 2016)

Data transfer instructions move the content of one register to another. The register the content of which is moved remains unchanged. If they have the suffix "X" (MOVX), the data is exchanged with external memory.

Examples

MOV dest, source dest ← source

- **Stack instructions**

PUSH byte ; increment stack pointer, ;move byte on stack
POP byte ; move from stack to byte, ; decrement stack pointer

- **Exchange instructions**

XCH a, byte ;exchange accumulator and byte
XCHD a, byte ;exchange low nibbles of ;accumulator and byte

PART B

1. Explain the various instruction set used in 8051 with examples.

The 8051 have in total of **255 instructions**. These instructions perform only 53 operations (addition, subtraction, copy etc.)

Depending on operation they perform, all instructions are divided in several groups:

- **Data Transfer Instructions**
- **Arithmetic Instructions**
- **Logical Instructions & Bit-oriented Instructions**
- **Branch Instructions**

5.1.1 DATA TRANSFER INSTRUCTIONS

Data transfer instructions move the content of one register to another. The register the content of which is moved remains unchanged. If they have the suffix "X" (MOVX), the data is exchanged with external memory.

- MOV dest, source dest ← source

- **Stack instructions**

PUSH byte ; increment stack pointer, ;move byte on stack
POP byte ; move from stack to byte, ; decrement stack pointer

- **Exchange instructions**

XCH a, byte ;exchange accumulator and byte
XCHD a, byte ;exchange low nibbles of
;accumulator and byte

5.1.2 ARITHMETIC INSTRUCTIONS

Add
Subtract
Increment
Decrement
Multiply
Divide
Decimal adjust

Mnemonic	Description
ADD A, byte	add A to byte, put result in A
ADDC A, byte	add with carry
SUBB A, byte	subtract with borrow
INC A	increment A
INC byte	increment byte in memory
INC DPTR	increment data pointer
DEC A	decrement accumulator
DEC byte	decrement byte
MUL AB	multiply accumulator by b register
DIV AB	divide accumulator by b register
DA A	decimal adjust the accumulator

INC A	increment A
INC byte	increment byte in memory
INC DPTR	increment data pointer
DEC A	decrement accumulator
DEC byte	decrement byte

- The increment and decrement instructions do NOT affect the C flag.
- We can only INCREMENT the data pointer, not decrement.

Multiply

When multiplying two 8-bit numbers, the size of the maximum product is 16-bits

MUL AB ; A * B
Note : The result is stored in B & A reg. B gets the High byte A gets the Low byte

Division

DIV AB ; divide A by B

A = Quotient(A/B)
B = Remainder(A/B)

OV - used to indicate a divide by zero condition.
C – set to zero

5.1.3. LOGICAL INSTRUCTIONS

Bitwise logic operations (AND, OR, XOR, NOT)
Clear

Rotate

Swap

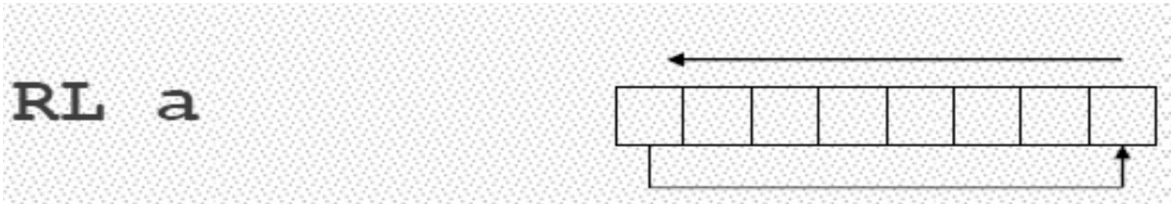
Bitwise logical operations

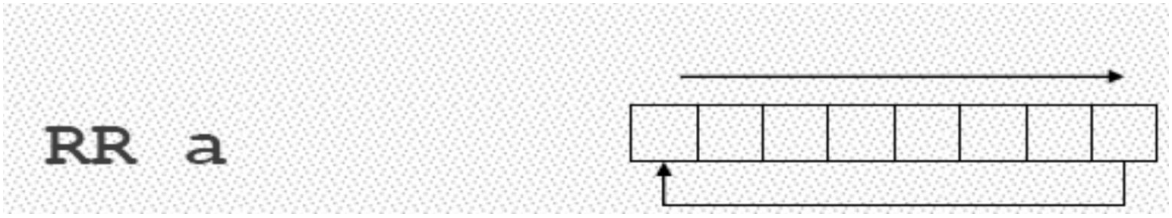
ANL (AND)
ORL (OR)
XRL (XOR)
CPL (Complement)

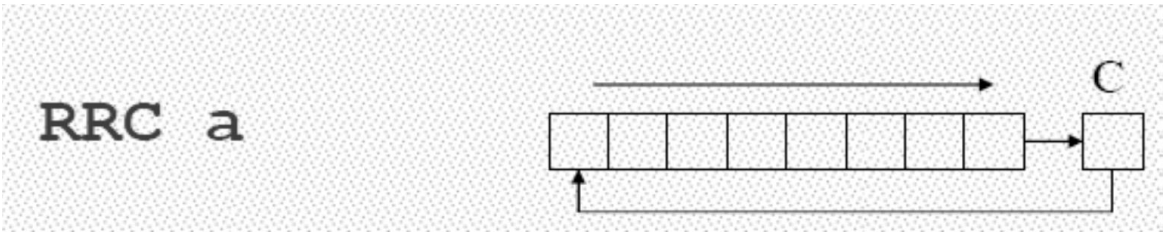
OTHER LOGICAL INSTRUCTIONS

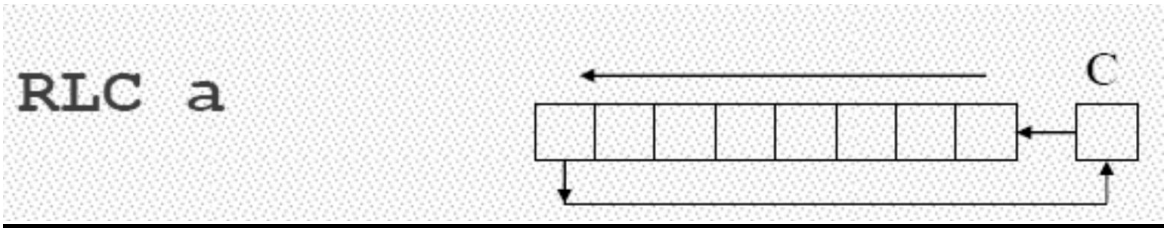
CLR - clear
RL – rotate left
RLC – rotate left through Carry
RR – rotate right
RRC – rotate right through Carry
SWAP – swap accumulator nibbles

ROTATE









5.1.4 PROGRAM FLOW CONTROL (BRANCH INSTRUCTIONS)

- **Unconditional jumps (“go to”)**
- **Conditional jumps**
- **Call and return**

Unconditional Jump

SJMP <rel addr> ; Short jump

LJMP <address> ; Long jump

AJMP <address> ; Absolute jump to anywhere within 2K block of program memory

JMP @A + DPTR ; Long indexed jump

Conditional Jump

These instructions cause a jump to occur only if a condition is true. Otherwise, program execution continues with the next instruction.

Mnemonic
JZ <rel addr>
JNZ <rel addr>
JC <rel addr>
JNC <rel addr>
JB <bit>, <rel addr>
JNB <bit>,<rel addr>
JBC <bir>, <rel addr>
CJNE A, direct, <rel addr>

Call and Return

Call is similar to a jump, but Call pushes PC on stack before branching

acall <address > ; PC to stack

lcall <address > ; PC to stack

Return

Return is also similar to a jump, but

Return instruction pops PC from stack to get address to jump to

ret ; stack to PC

---

2. Explain the various addressing modes of 8051 with examples.

5.2.1 IMMEDIATE MODE

This mode specify data by its value

MOV A, #0

MOV R4, #10 H

MOV B, # 07

MOV DPTR,# 2500 H

5.2.2 REGISTER ADDRESSING

Either source or destination is one of register

```
MOV R0,A
MOV A,R7
ADD A,R7
MOV DPTR,#25F5H
MOV R5,DPL
```

5.2.3DIRECT ADDRESSING MODE

Specify data by its 8-bit address

```
MOV A, 70H          ; copy contents of RAM at 70h to a
MOV R0,40H      ; copy contents of RAM at 70h to a
```

5.2.4.REGISTER INDIRECT

The address of the source or destination is specified in registers. Uses registers R0 or R1 for 8-bit address:

```
mov psw, #0             ; use register bank 0
mov r0, #0x3C
mov @r0, #3
```

Uses DPTR register for 16-bit addresses:

MOV DPTR, #0X9000 ; DPTR ← 9000HS
MOVX A, @DPTR ; A ← M[9000]

9000 is an address in external memory

5.2.5 REGISTER INDEXED MODE

Source or destination address is the sum of the base address and the accumulator (Index).**Base address can be DPTR or PC**

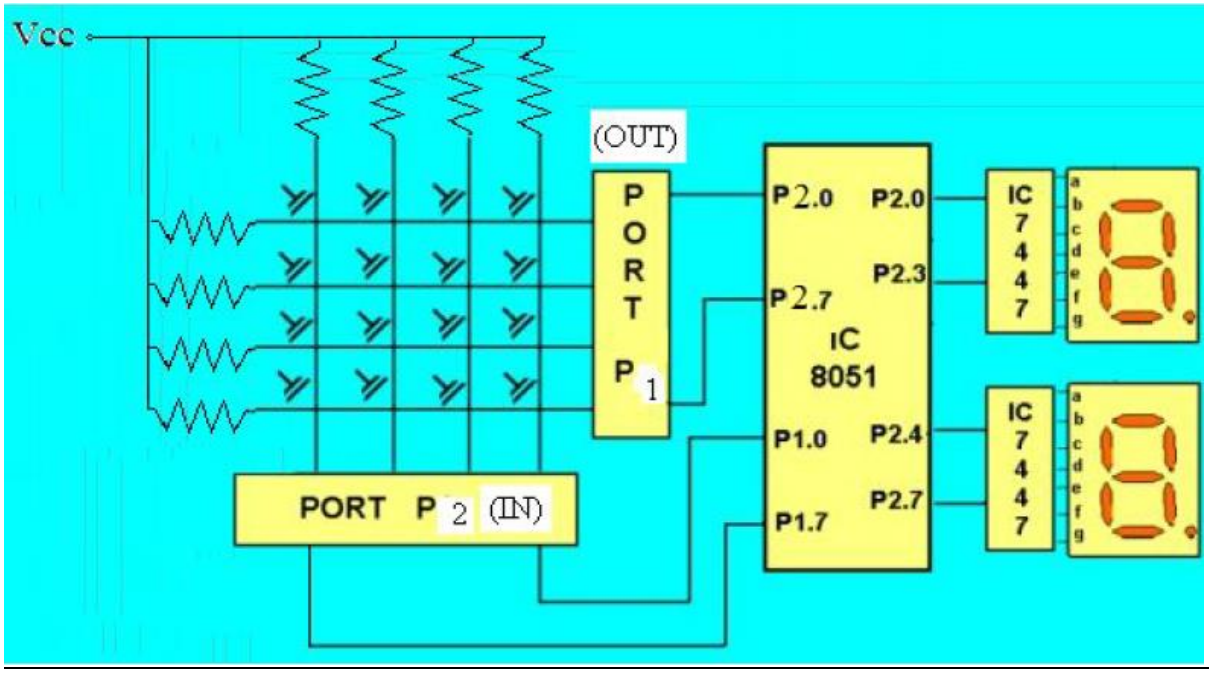
MOV DPTR, #4000H

---

3. (a) Write a program to interface a LCD display to 8051 microcontroller (Dec 2016,May 2016)
(b) **Write a program to interface a Keyboard to 8051 microcontroller.**

3.1 KEY BOARD INTERFACING

The key board is designed with a particular rows and columns (matrix). These rows and columns are connected to the microcontroller through its ports of the micro controller 8051.



- First make sure that the preceding key has been released, 0s are output to all rows at once, and the columns are read and checked repeatedly until all the columns are high.

- When all columns are found to be high, the program waits for a short amount of time before it goes to the next stage of waiting for a key to be pressed.
- Columns re scanned over and over in an infinite loop until one of them has a 0 on it. Rows are 0. After a key is pressed mp wait for 20ms and then scans the column again

- To detect which rows the key press belongs to , the mp grounds one row at a time, if it finds that all columns are high, this means that the key press cannot belong to that row, therefore, it grounds the next row and continues.

- After finding the key, it sets up the starting address for the lookup table holding the scan codes To identify the key pressed the mp controller rotates the column bits one bit at time, in to carry flag and checks to see if its low.

- If zero, it pull the ASCII code for that key from the look-up table. Otherwise it increment the pointer to point the next element of the look-up table.

- The program for key board interfacing is given below.

PROGRAM

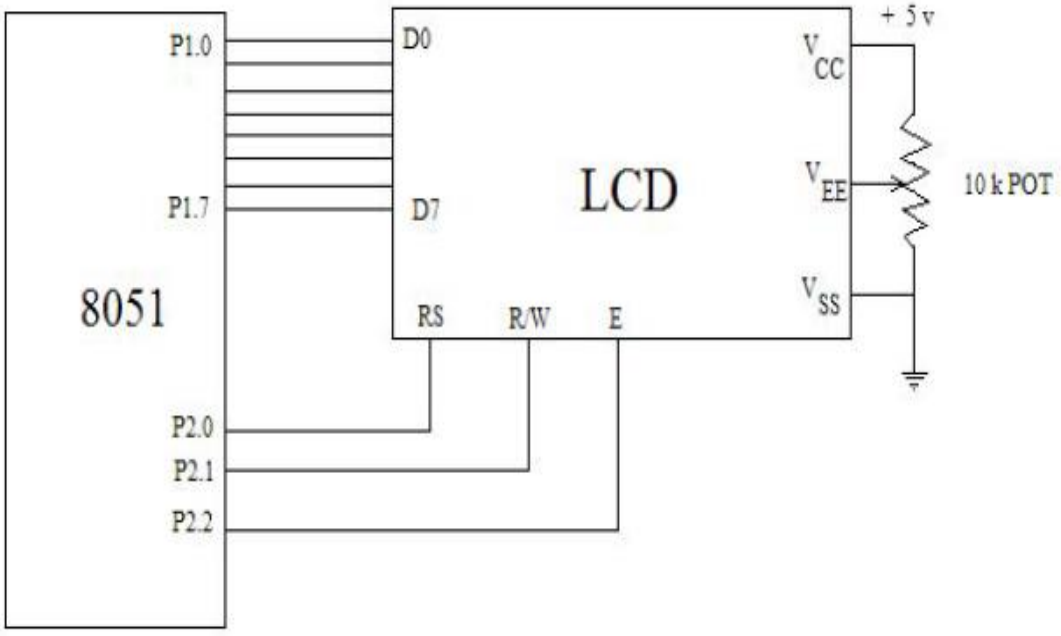
(P1.0 – P1.3 are connected to rows P2.0 –P2.3 connected to columns)

```
      MOV P2, #0FFH
K1: MOV P1, #0
      MOV A, P2
      ANI A, #00001111
      CJNE A, #00001111, K1
K2:  ACALL DELAY
       MOV A, P2
       ANI A, #00001111
      CJNE A,#00001111, OVER
      SJMP K2

OVER1: MOV P1, #11111110
           MOV A,P2
           ANI A, #00001111
           CJNE A,#00001111, ROW0
           MOV P1, #11111101
            MOV A,P2
          ANI A, #00001111
          CJNE A,#00001111, ROW1
         MOV P1, #11111011
          MOV A,P2
         ANI A, #00001111
        MOV P1, #11110111
        MOV A,P2
       ANI A, #00001111
       CJNE A,#00001111, ROW3
        LJMP K2
```

```
ROW0: MOV DPTR,#KCODE0
SJMP FIND
ROW1: MOV DPTR,#KCODE1
SJMP FIND
ROW2: MOV DPTR,#KCODE2
SJMP FIND
ROW3: MOV DPTR,#KCODE3
FIND: RRC A
JNC MATCH
INC DPTR
SJMP FIND
MATCH: CLR A
MOVC A,@A+DPTR
MOV P0,A
LJMP K1
```

```
Look-up table
Org 300h
Kcode0: DB '0' , '1', '2', '3'
Kcode1: DB '4' , '5', '6', '7'
Kcode2: DB '8' , '9', 'A', 'B'
Kcode3: DB 'C' , 'D', 'E', 'F'
End
```

3.2 LCD (DISPLAY) INTERFACING



The following setup is maintained to interface a LCD display with 8051 MC.

- To send command to LCD RS= 0, for data RS=1

- P1.0 to P1.7 – are connected to LCD data/command
- P2.0 is connected to RS pin of LCD
- P2.1 is connected to R/W pin of LCD
- P2.2 is connected to E pin of LCD

PROGRAM

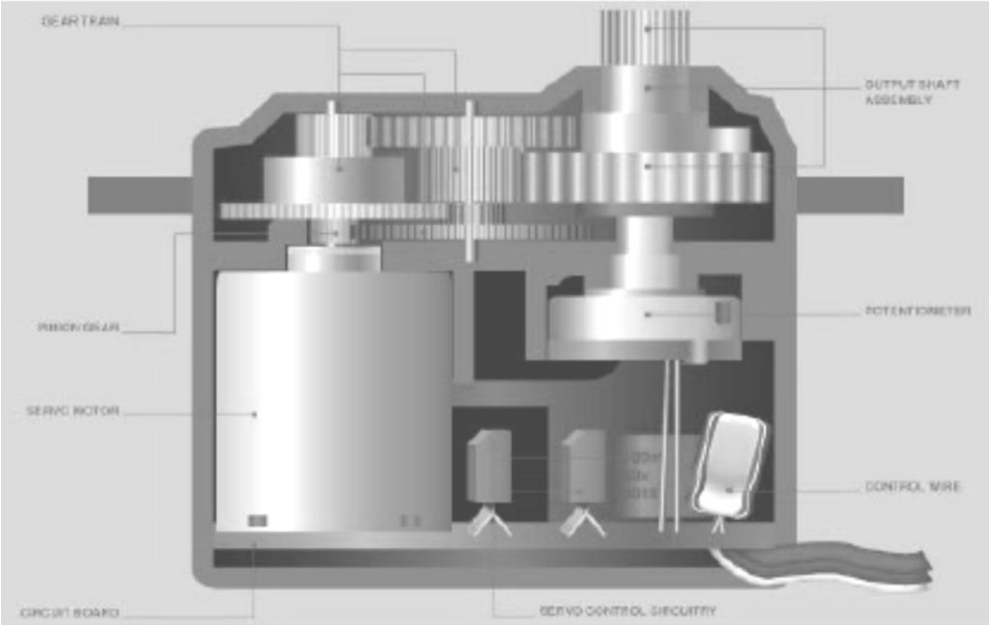
```
MOV A, # 38H ;                  init. Lcd 2 line, 5*7 matrix
ACALL COMMAND
MOV A,# 0EH ;                   display on cursor on
ACALL COMMAND
MOV A,#01H ;                    clear LCD
ACALL COMMAND
MOV A,#06H ;                    shift cursor right
ACALL COMMAND
MOV A,#84H ;                    cursor at line 1, position 4
ACALL COMMAND
MOV A, # 'N' ;                  display letter N
ACALL DATAWRT
MOV A,# 'O' ;                   display letter O
ACALL DATAWRT
HERE: SJMP HERE

COMMAND: ACALL READY
MOV P1,A
CLR P2.0 ;                      RS =0 for command
CLR P2.1 ;                      R/W =0 for write
SETB P2.2 ;                     E=1 for high pluse
CLR P2.2 ;                      E=0
RET

DATAWRT:

ACALL READY
MOV P1,A
SETB P2.0 ;                     RS =1 for data
CLR P2.1 ;                      R/W =0 for write
SETB P2.2 ;                     E=1 for high pluse
ACALL DELAY
CLR P2.2 ;                      E=0
RET

READY: SETB p1.7   ;            Make p1.7 as input port
CLR p2.0           ;            Access command register
SETB p2.1          ;            Read command register (R/W =1)

BACK : CLR p2.2
```

```
ACALL DELAY
SETB p2.2
JB p1.7, BACK
 RET
  END
```

---

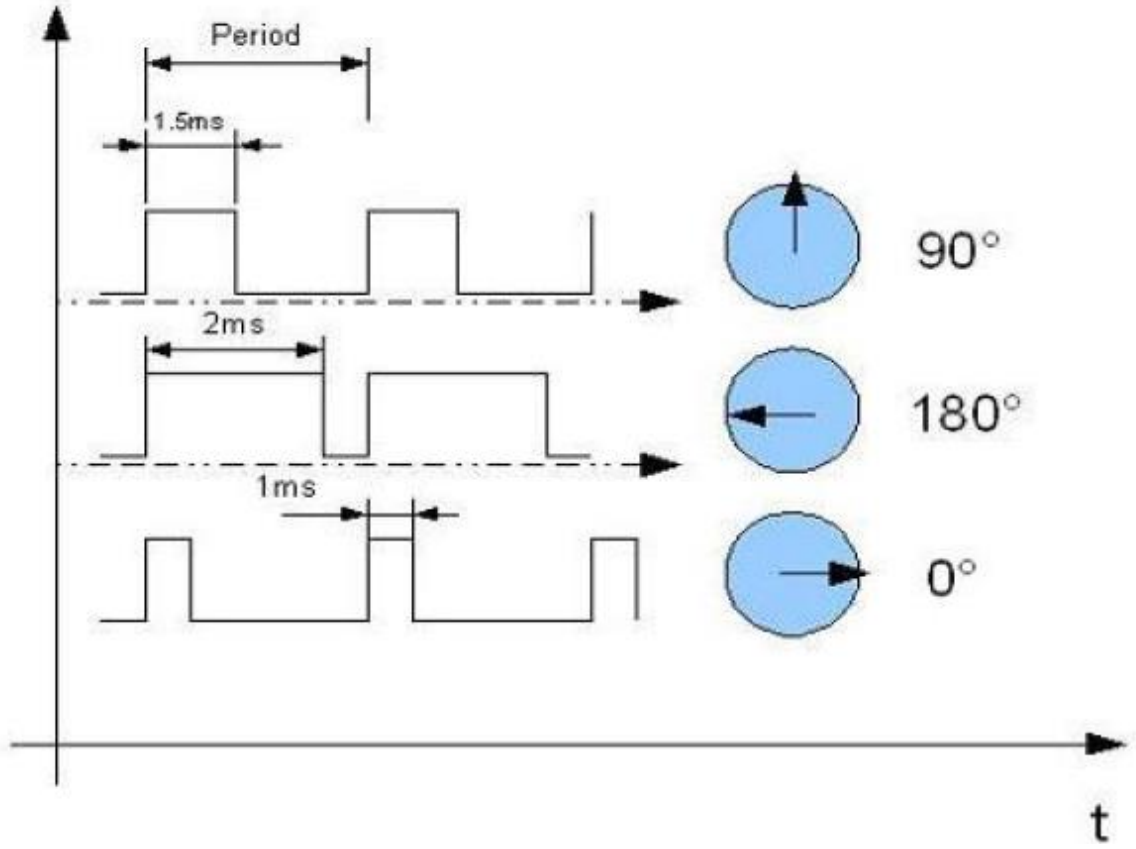
4. Draw the schematic for interfacing a servo motor with 8051 microcontroller and write 8051 ALP for servo motor control. (May/Jun 2016)

- Servo motors are so called "closed feedback" systems.
- This means that motor comes with control circuit, which senses if motor mechanism is in desired location and if not it continuously corrects an error until motor reaches proper point.
- Servo motors are widely used in robotics, remote controlled planes, and vehicles.
- The various parts of a servo motor is shown in the following Figure.



SERVO CONTROL SIGNALS

- Servo motor shaft is positioned with pulse width modulated signals. So all servos comes with three wires (Power, Ground and Control). So pulses are sent via control wire.
- Usually in servos with rotation angle 90° signal width vary between 1 and 2ms. If pulse is more wide rotation continues until reaches mechanical limits. This is shown in the below Figure.



MAIN PROGRAM

```
ORG 0000H
MAIN: MOV A,P0
MOV R1,A
ANL A,#01H
XRL A,#01H
JZ M1
MOV A,R1
ANL A,#02H
XRL A,#02H
JZ M1.5
MOV A,R1
ANL A,#04H
XRL A,#04H
JZ M2
AJMP  MAIN
```

SUB

1 ms DELAY

```
M1: MOV R6, #01H ; LOAD 10D IN R6
ACALL DELAY ; CALL 1 MS DELAY
```

```
CLR P2.0 ; SEND 0 TO PORT PIN
MOV R6, #01H ; LOAD 1D IN R6
ACALL DELAY ; CALL 1 MS DELAY
DELAY:
LP2: MOV R7, #0FAH
LP1: NOP ; 1 CYCLE
NOP ; 1+1=2 CYCLES
DJNZ R7, LP1 ; 1+1+2 = 4 CYCLES
DJNZ R6, LP2 ; 4×250 = 1000 CYCLES = 1000 MS = 1 MS
 RET
```

1.5 ms Delay

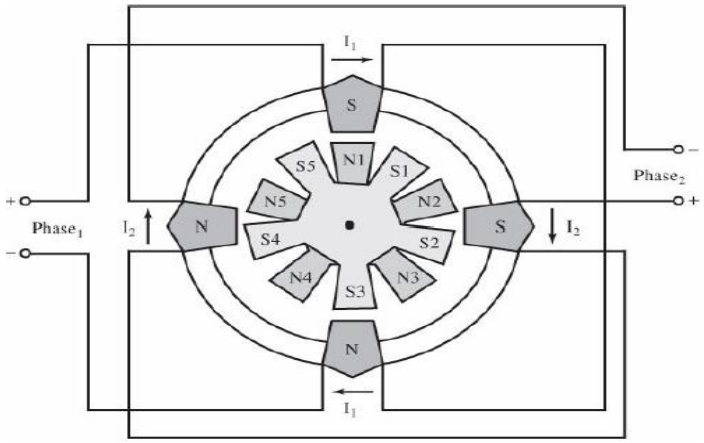
```
M1.5: MOV R6, #02H ; LOAD 10D IN R6
ACALL DELAY ; CALL 1 MS DELAY
CLR P2.0 ; SEND 0 TO PORT PIN
MOV R6, #02H ; LOAD 1D IN R6
ACALL DELAY ; CALL 1 MS DELAY
DELAY:
LP2: MOV R7, #0FAH
LP1: NOP ; 1 CYCLE
NOP ; 1+1=2 CYCLES
DJNZ R7, LP1 ; 1+1+2 = 4 CYCLES
DJNZ R6, LP2 ; 4×375 = 1000 CYCLES = = 1.5 MS
LP3: MOV R7, #07DH
LP4: NOP ; 1 CYCLE
NOP ; 1+1=2 CYCLES
DJNZ R7, LP4 ; 1+1+2 = 4 CYCLES
DJNZ R6, LP3 ; 4×125 = 500 CYCLES = 500 MS = .5 MS
RET
```

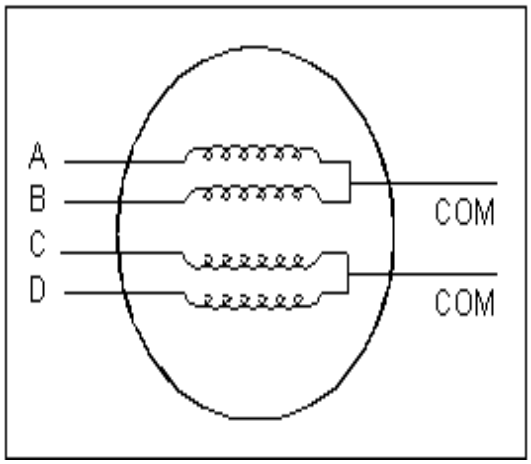
2 ms delay

```
M2: MOV R6, #02H ; LOAD 10D IN R6
ACALL DELAY ; CALL 1 MS DELAY
CLR P2.0 ; SEND 0 TO PORT PIN
MOV R6, #02H ; LOAD 1D IN R6
ACALL DELAY ; CALL 1 MS DELAY
DELAY:
LP2: MOV R7, #0FAH
LP1: NOP ; 1 CYCLE
NOP ; 1+1=2 CYCLES
DJNZ R7, LP1 ; 1+1+2 = 4 CYCLES
DJNZ R6, LP2 ; 4×250 = 1000 CYCLES = 1000 MS = 1 MS
RET
```

5. Draw the schematic for interfacing a stepper motor with 8051 microcontroller and write 8051 ALP for changing speed and direction of motor. (Nov/Dec 2015, May/Jun 2016)

- **A stepper motor is a special type of electric motor that moves in increments, or steps, rather than turning smoothly as a conventional motor does.**
- This Motor Moves Each Time a Pulse is Received Can Control Movement (Direction and Amount) Easily. It Can Force Motor to Hold Position Against an Opposing Force. The conceptual diagram of stepper motor is shown below.





Step Angle

The step angle is defined as

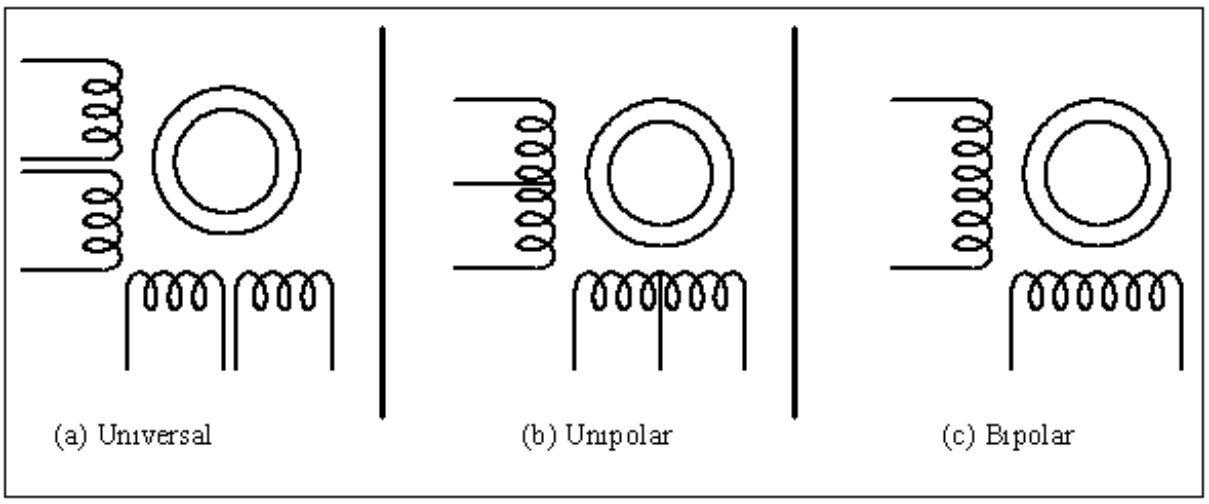
Step angle = 360/No. of Steps per Revolution

- Note : Commonly available no. of steps per revolution are 500, 200, 180, 144, 72, 48, 24

Revolutions per Minute (RPM)
RPM is defined as

$$rpm = \frac{60 \times Steps\ per\ Second}{Steps\ per\ \mathrm{Re}volution}$$

Common Stepper Motor Types



Drivers

May Need a Driver Circuit. The Reason for driver circuit is, The power consumption range is different for MP and stepper motor. The transition drivers are normally used (Usually a Darlington Pair).

PROGRAM (ANTI CLOCKWISE ROTATION)

```
MOV A, # 66
BACK : MOV P1, A
RL A
ACALL DELAY
SJMP BACK
DELAY
MOV R2, #100
L1: MOV R3, #255
L2: DJNZ R3, L2
DJNZ R2, L1
```

PROGRAM (CLOCKWISE ROTATION)

```
MOV A, # 66
```

```
BACK : MOV P1, A
RR A
ACALL DELAY
SJMP BACK
DELAY
MOV R2, #100
L1: MOV R3, #255
L2: DJNZ R3, L2
DJNZ R2, L1
```

---

6. Explain in detail about washing machine control using 8051.(Nov/Dec 2015, Dec 2016)

OPERATIONS OF A WASHING MACHINE

Fill:- water will be filled by the pump as per the load knob selected.

Agitate:- The wash basket will rotate in a clockwise direction for 10 revolutions, After that basket will stop for 2 seconds, then rotate 10 revolutions in anticlockwise direction. The process will be continued for specified minutes in cycle table.

Drain:- After agitation, the water and detergent are drained.

Spin:- During spin, agitator will be stationary, only the basket will rotate at high speed. Then the moisture of clothes are removed through holes in the inner metallic basket.

Indicator:- Machine ON : LED ON

After completion of washing cycle, buzzer sound will be generated.

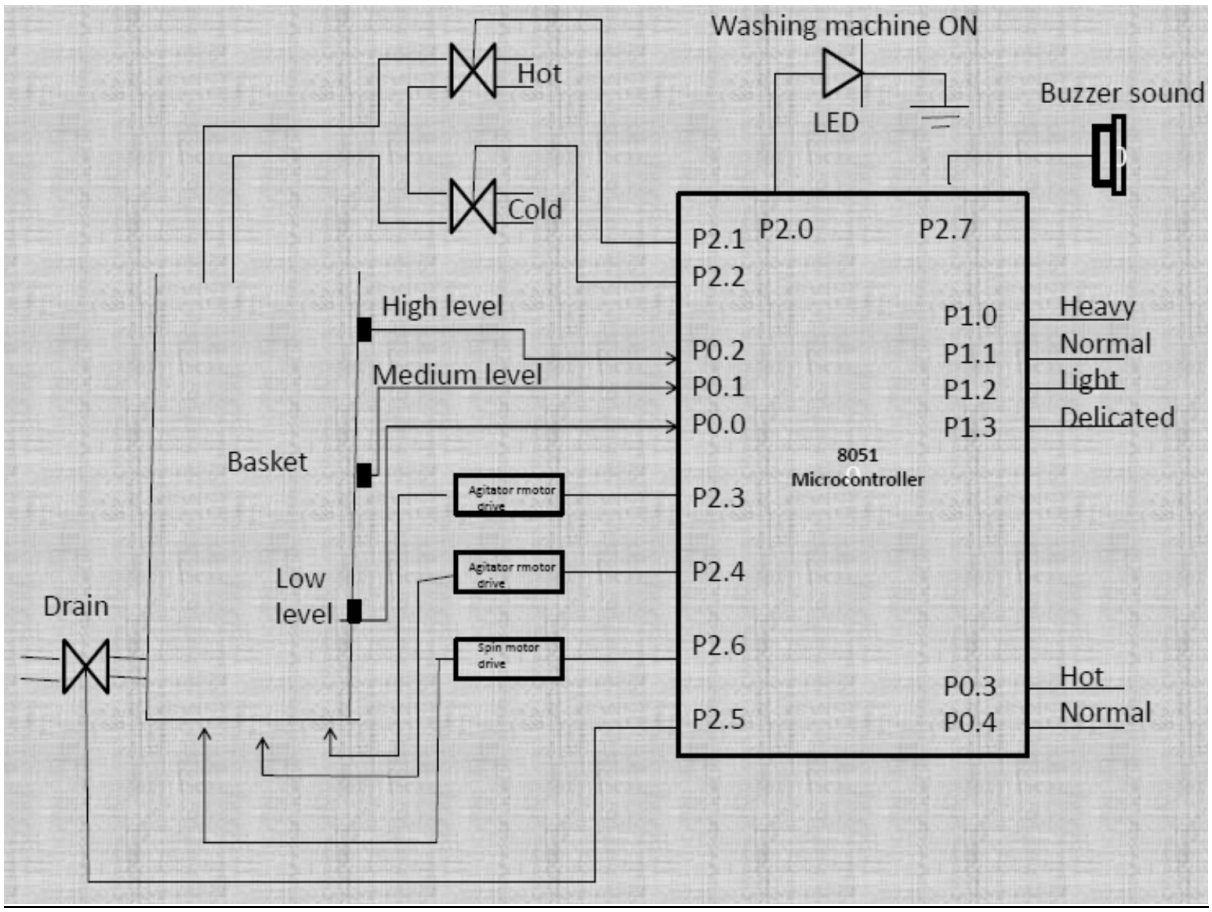
WASHING CYCLE FOR HEAVY, NORMAL, LIGHT AND DELICATE SETTING

Operation	Heavy	Normal	Light	Delicate
Fill water	Set by load Select knob	Set by load Select knob	Set by load Select knob	Set by load Select knob
Agitate	20 minutes	15 minutes	10 minutes	5 minutes
Drain	5 minutes	5 minutes	5 minutes	5 minutes
Fill water	Set by load Select knob	Set by load Select knob	Set by load Select knob	Set by load Select knob
Agitate	10 minutes	10 minutes	5 minutes	5 minutes
Drain	5 minutes	5 minutes	5 minutes	5 minutes
Spin	10 minutes	10 minutes	5 minutes	5 minutes

CONTROL KNOBS IN WASHING MACHINE

- Load select knob
- Water inlet select knob
- Mode select knob
- Program select knob

WASHING MACHINE CONTROL CIRCUIT DIAGRAM



PORTS USED

Operation	Signal	Input/output	Port pin no.
Load / water level select	Water level low Water level med Water level high	Input Input Input	P0.0 P0.1 P0.2
Water inlet	Hot water knob Normal water knob	Input Input	P0.3 P0.4
Program select	Heavy Normal Light Dedicate	Input Input Input Input	P1.0 P1.1 P1.2 P1.3
Machine ON	Machine on indic	Output	P2.0
Fill water	Hot water inlet Normal water inlet	Output Output	P2.1 P2.2
Agitation control	Motor rotate in cloc direction Motor rotate in anticlock direc	Output Output	P2.3 P2.4
Drain	Drain valve open	Output	P2.5
Spin	Spin motor ON/OFF	Output	P2.6
Washing ccomplete	Washing comp indic	Output	P2.7

WASHING MACHINE CONTROL PROGRAM

Labels	Mnemonics	Operands	Comments
	SETB LCALL JNB SJMP	P2.0 FILL_1 P1.0,LOOP_1 HEAVY	Machine ON indication Machine fill with water 1st time Chk prog setng knob for heavy. if P1.0 is not set,jump to LOOP_1 If P1.0 is set,jump to HEAVY
LOOP_1	JNB SJMP	P1.1,LOOP_2 NORMAL	Check prog setng knob for normal.if P1.1 is not set.jump to LOOP_2 If P1.1 is set, jump to NORM
LOOP_2	JNB SJMP	P1.2,LOOP_3	Chck prog setng knob for normal.if P1.2 is not set,jump to LOOP_3 If P1.2 is set,jump to LIGHT
LOOP_3	JNB SJMP	P1.3,LOOP_4 DELICATE	Check prog set knob for delicate. If P1.3is not set,jump to LOOP_4 If P1.2 is set,jump to delicate
DISPLAY	SETB	P2.7	Indicate the completion of wash cycle.
LOOP_4	NOP LJMP	 0000	 End of program
